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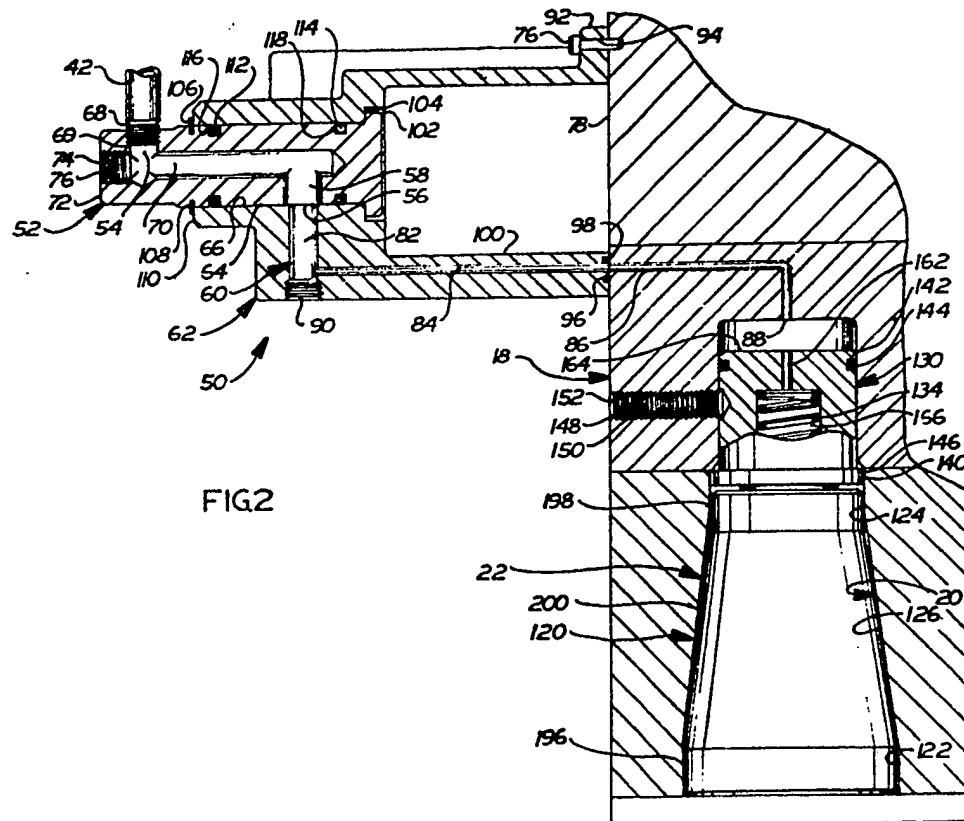
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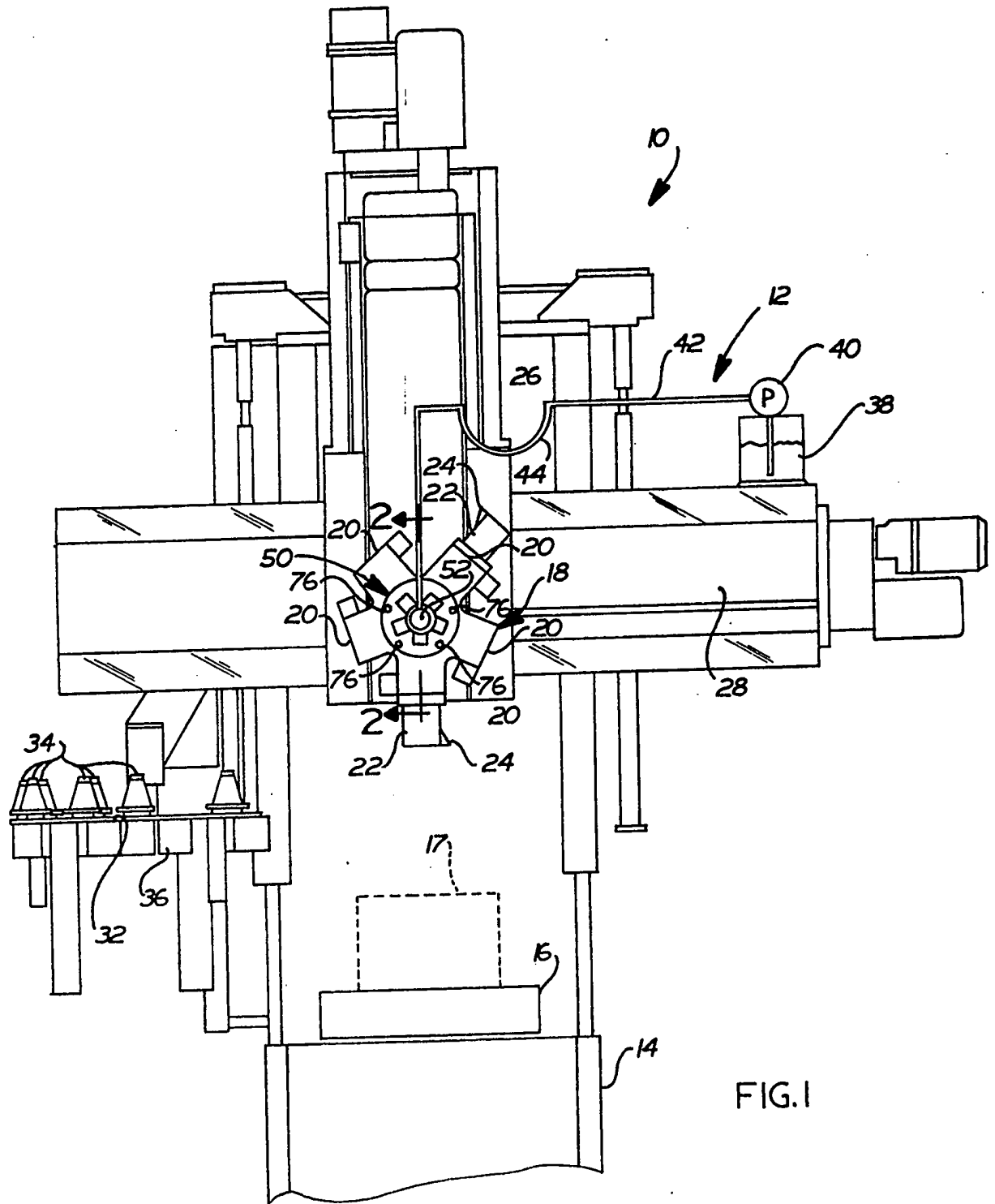
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(54) Machine tool coolant system

(57) In a coolant system for a machine tool, a coolant supply distributor (50) is mounted on a rotatable tool and turret (18) of the machine to be coaxial with the axis of rotation of the turret and coolant is piped into the center of a distributing member (52) which has an outlet (56). A receiving member (62) has a cylindrical chamber in which the distributing member is rotatably disposed, and is formed with a plurality of radially disposed passages (60) which lead from the receiving member to tool receiving sockets (20) on the turret. Coolant flows

only to a tool in the working position because only the passage leading to that tool is aligned with the outlet (56) of the distributing member. As the turret is rotated to index a different tools to the working position, coolant is ported to the passage leading to the tool then in the working position. Each socket (20) is equipped with a check valve (130) biased to a closed position, and opened upon insertion of a tool.







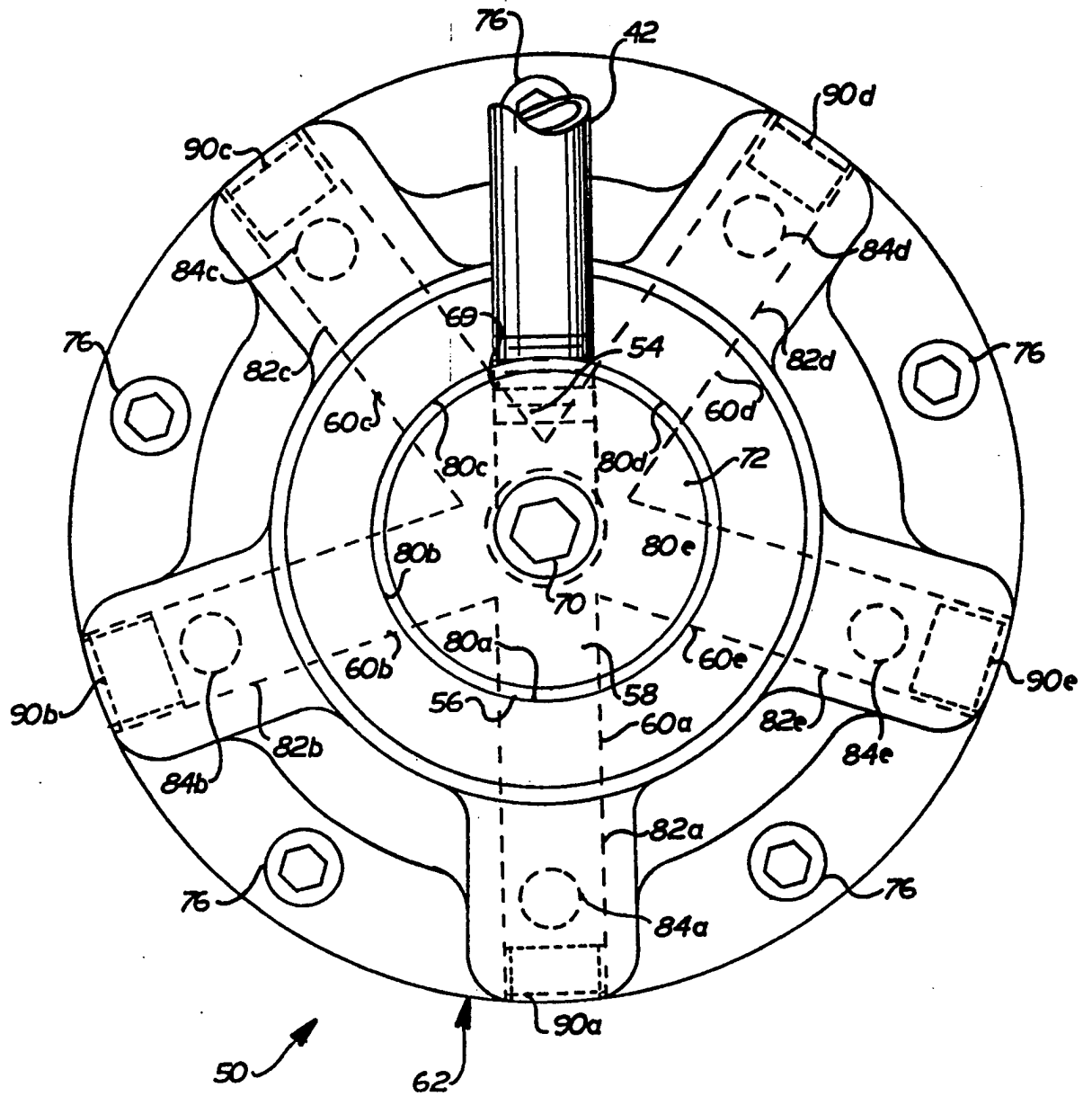


FIG.3

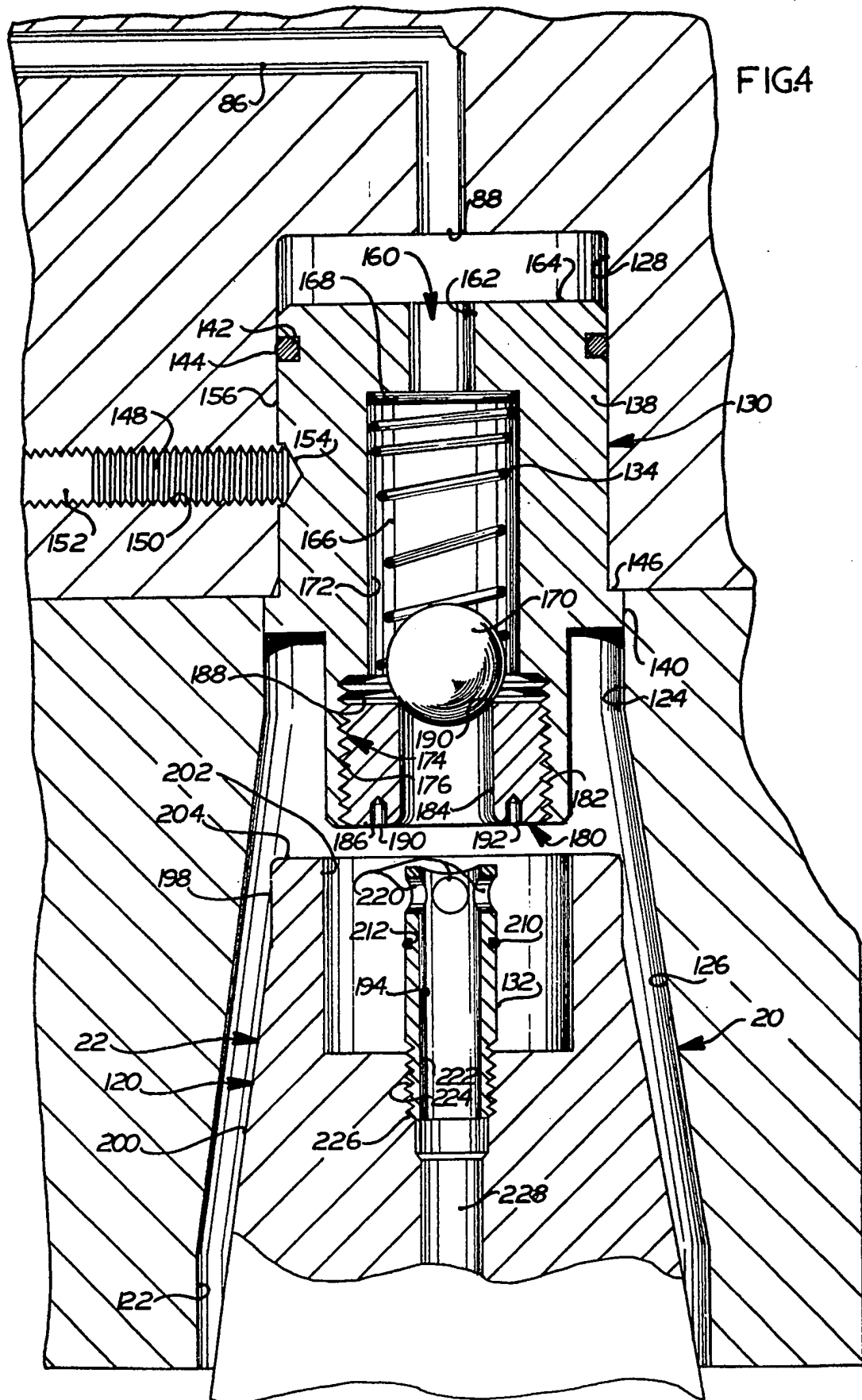
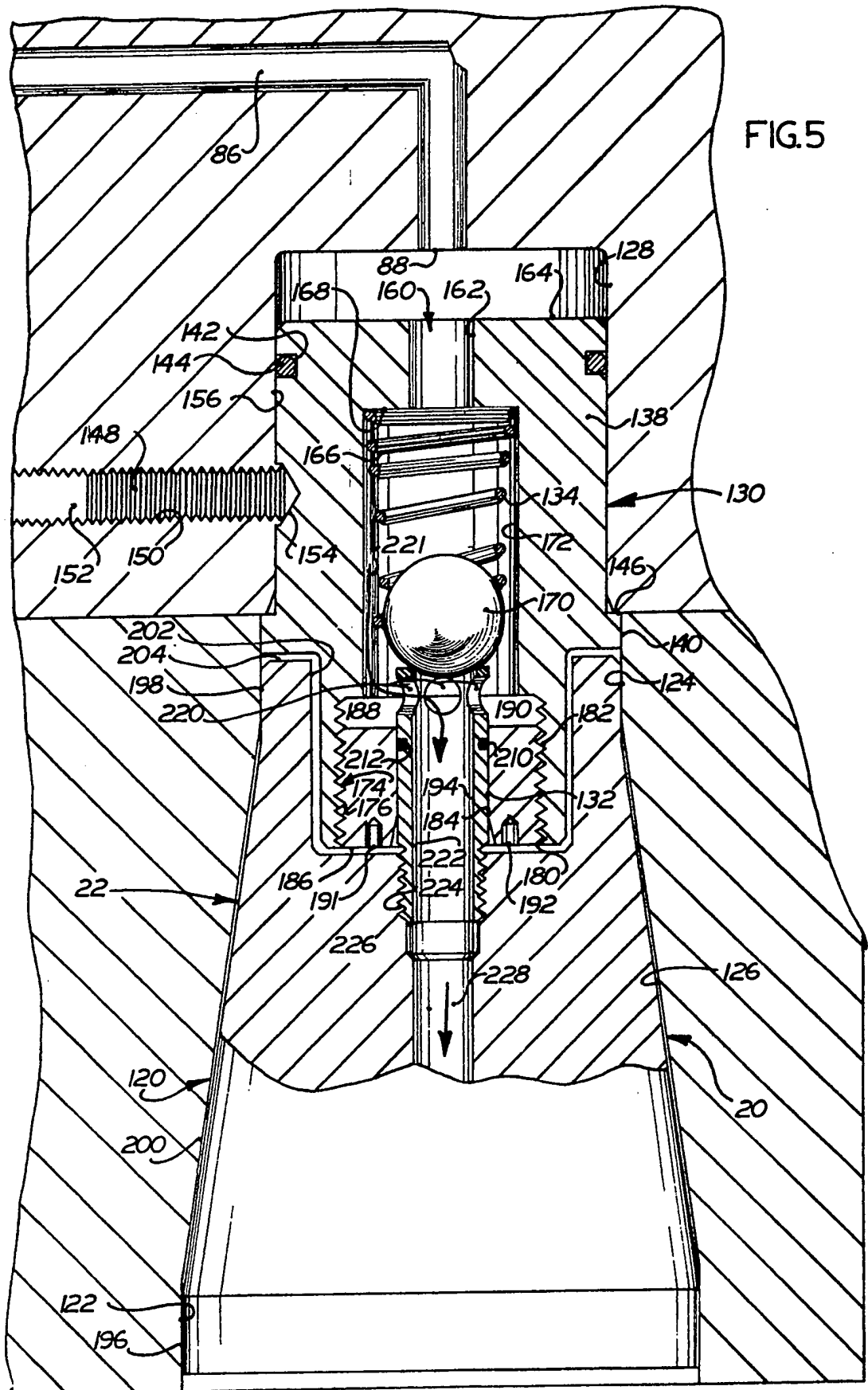


FIG.5





## SPECIFICATION

### Machine tool coolant system

- 5 The present invention relates generally to machine tools and more particularly to a coolant system for supplying cooling fluids to a cutting tool during machining operations.

- 10 In the past attempts have been made to supply coolant to the cutting edge of a tool during machining operations. Some known cooling systems are disclosed in U.S. Patent No. 3,893,355; 1,359,955 and 487,847. While the past attempts have been more or less successful in supplying coolant, it is believed that the present invention represents a substantial improvement.

- 15 Prior systems have been devised which accommodate a machine tool having an automatic tool changer. But prior systems have not provided a simple method for preventing a flow of coolant when a tool is absent during a tool changing operation. Further prior systems have not provided an automatic coolant cut off to a tool which does not require coolant. In addition, when using a coolant system on a machine tool having a rotatable turret with a plurality of tools, each able to be indexed to a working position, a mechanism must be provided which supplies coolant only to the cutting tool in the working position.

### SUMMARY OF THE INVENTION

- 20 The present invention provides a new and improved coolant system for a machine tool having a rotatable turret. A distributor ports coolant only to the turret socket indexed to the working position. A non-rotatable distributing member has a single coolant outlet. A manifold is fixedly connected and coaxial with the turret of the machine tool. It includes a separate passage associated with each tool holding socket for conducting coolant from a receiving surface to the associated socket. The receiving ends of these passages are in alignment with the coolant outlet only when the associated socket has been indexed to the working position.

- 25 In addition, the present invention provides a check valve assembly in each socket and an actuator member on selected tools. The check valve permits coolant to flow only when a tool is in the socket and then only when the tool is equipped with an actuator member. The check valve assembly includes a circular valve seat and a spherical valve member. A biasing spring urges the valve member toward a closed position abutting the valve seat. If the tool is one which requires coolant, it is equipped with an actuator pipe which will project upward through the valve seat to lift the valve member off the valve seat when the tool is inserted in the socket. Coolant may then flow around the valve member and through the pipe toward the cutting edge of

the tool. Tools not requiring coolant are not equipped with an actuator pipe.

- Accordingly, it is an object of the present invention to provide a new and improved flood coolant system for a machine tool wherein the tool-receiving socket of the machine tool is provided with a check valve biased to a closed position to prevent coolant flow and the tools adapted to be received in the socket of the machine tool are provided with actuators for opening the check valve to enable coolant to flow to the cutting edge of the machine tool.

- It is a further object of this invention to provide a coolant system for use with a plurality of tools, any one of which may be indexed to the working position, and wherein the system includes a distributor for directing coolant only to the tool indexed to the working position.

### BRIEF DESCRIPTION OF THE DRAWINGS

- These and other objects and features of the invention will become apparent upon reading the following description with reference to the drawings in which:

*Figure 1* is a front elevational view of a machine tool equipped with the coolant system of the present invention;

- Figure 2* is an enlarged sectional view taken along line 2-2 of Fig. 1 showing a coolant distributor constructed in accordance with the present invention;

- Figure 3* is an enlarged front elevational view of the distributor of Fig. 2;

- Figure 4* is an enlarged sectional view of a tool-receiving socket on the machine tool of Fig. 1 and showing a tool before it is fully seated in the socket and a coolant flow control valve in the socket in a closed condition;

*Figure 5* is a view similar to Fig. 4, but showing a tool fully seated in the socket and the coolant flow control valve of Fig. 4 in an open condition; and

- Figure 6* is a view similar to Fig. 5 but showing another tool fully seated in the socket and the coolant flow control valve in the closed condition.

### DESCRIPTION OF A SPECIFIC PREFERRED EMBODIMENT OF THE INVENTION

- A machine tool 10 having a flood coolant system 12 constructed in accordance with the present invention includes a base 14 which supports a rotating table 16 (Fig. 1). The workpiece 17 (shown in phantom) is mounted to the table 16.

- The machine tool 10 also includes a rotatable turret 18. The turret 18 includes a plurality of conical sockets 20 adapted to receive cutting tools 22. The turret 18 is rotatable to index each tool holding socket 20 to a working position in which the socket faces downwardly toward the workpiece 17. When the tool 22 in the socket 20 which has been

indexed to the working position is brought into contact with the rotating workpiece, the cutting edge 24 of the tool 22 cuts away portions of the rotating workpiece. The turret 18 is movable horizontally and vertically with respect to the workpiece on guide rails 26 and 28.

The machine tool 10 (Fig. 1) also includes means for automatically changing the cutting tool 22. A carousel 32 supporting a plurality of tools 34 is disposed to the side of the rotating table 16. When a tool 22 is to be changed, the turret 18 is moved into a position directly above the carousel 32. The carousel 32 is rotated until an empty tool gripper 36 on the carousel is disposed beneath the tool 22 in the turret 18. Then the turret 18 is lowered onto the tool gripper 36 and the tool is disengaged from the socket 20. The turret 18 is next raised, and the carousel 32 is rotated until a desired tool 34 is located beneath the turret. The turret 18 is then lowered onto the desired tool 34 which is engaged by the socket 20. The turret 18 may then be moved back to a position in which the cutting edge 24 of the tool 22 is disposed in contact with the rotating workpiece.

A machine tool 10 is constructed in accordance with the present invention also includes a flood coolant system 12. The system includes a refillable reservoir 38 (Fig. 1) which provides a source of coolant. The reservoir 38 is mounted on the machine tool 10 in any convenient location. A pump 40 is connected with the reservoir and supplies coolant under pressure. A conduit 42 leads from the pump 40 to the turret 18 and includes a flexible portion 44 in order to accommodate the horizontal and vertical motion of the turret. A distributing system 50 on the turret 18 directs the coolant to the cutting edge 24 of the tool 22 which has been indexed to the working position.

In operation, the coolant flows from the reservoir 38 through the conduit 42 under pressure supplied by the pump 40 to a nonrotatable distributing member 52 (see Figs. 1, 2 and 3). The coolant enters the distributing member 52 at a first radial passage 54 (Fig. 2) and leaves via an outlet 56 at the end of a second radial passage 58. The coolant then enters one of five radial passages 60a, 60b, 60c, 60d, 60e (Fig. 3) in a manifold 62 and is directed to an associated tool socket 20.

When the turret 18 rotates to change which tool 22 is in the working position, the manifold 62 rotates with the turret relative to the distributing member 52. This results in a blocking of coolant flow to the tool socket 20 which was previously in the working position and a porting of coolant to the tool socket which moves into the working position. Thus, the radial manifold passage 60a (Fig. 3) which was aligned with the radial passage 58 in the distributing member 52, is no longer

aligned with the outlet of the distributing member 52. Instead, a different radial passage 60b, c, d, or e in the manifold 62 is brought into alignment with the outlet 58 of the distributing member 52. The outlet 56 of the distributing member 52 is aligned with the turret 18 and the machine tool base 14 so that coolant is fed to only the turret socket 20 which is in the working position.

The distributing member 52 (Fig. 2) is fixedly connected with a rigid end portion of the conduit 42 which leads from the pump 10. The distributing member 52 is generally cylindrical and is disposed in a coaxial relationship with the axis of rotation of the turret 18. However, the distributing member 52 does not rotate with the turret 18. The distributing member 52 includes a cylindrical distributing surface 64 (Fig. 2) disposed in sliding abutting engagement with a similarly shaped receiving surface 66 on the manifold 62.

The conduit 42 from the pump 40 includes a threaded end portion 68 which is screwed into similar threads 69 in the first radial passage 54 in the distributing members 52 (Fig. 2). The radial passage 54 extends from the outside surface of the distributing member 52 to its center where it joins a cylindrical axial passage 70 which extends from a circular end 72.

A plug 74 fills the opening at the circular end 72 of the distributing member 52 formed by the axial passage 70; this plug 74 prevents leakage of coolant.

The axial passage 70 connects with the radial passage 58 which extends from the axial passage 70 to the surface 64 of the distributing member 62 where it forms an opening on the distributing surface 64. The second radial passage 58 meets the surface 64 of the distributing member 62 at a location diametrically opposed and axially displaced from the first radial passage 54. Together the radial passages 54 and 58 and the axial passage 70 through the distributing member form a path through which the pressurized coolant flows.

When coolant leaves the distributing member 52 it enters one of five passages 60a, 60b, 60c, 60d, and 60e in the manifold 62 (Fig. 3). The manifold 62 is connected with the turret 18 and rotates with it. In the present instance, five bolts 76 hold the manifold securely to the face 78 of the turret 18.

The manifold 62 includes a receiving surface 66 which is generally cylindrical and coaxial with the axis of rotation of the turret 18. The receiving surface 66 has five openings 80a, 80b, 80c, 80d, and 80e (Fig. 3) each forming one end of a passage 60a, 60b, 60c, 60d and 60e leading to one tool socket 20. Each passage 60 to a socket 20 has a first portion 82 extending radially outward from and perpendicular to the receiving sur-

face 66 (Figs. 2 and 3). Each such radially extending first portion 82 is axially aligned with the outlet 56 of the distributing member 52. However, only one such radially extending passage 82 can be aligned with the outlet 56 of the distributing member 52 to enable coolant to flow into that passage. Thus relative rotation of the distributing members 52 and the manifold 62 brings each opening 80a, 80b, 80c, 80d and 80e in the manifold 52 successfully into alignment with the distributing member outlet 56. Thus coolant is directed to only one receiving passage 82 in the manifold 62 at a time.

Each radial receiving passage 82 in the manifold 61 is connected with an associated passage 84a, 84b, 84c, 84d and 84e (Figs. 2 and 3) which leads to the turret 18. The passages 84 are perpendicular to the receiving passages 82. Each of the passages 84 communicate with passages 86 in the turret 18. Each turret passage 86 leads to an outlet 88 coaxial with the axis of an associate one of the sockets 20 (Fig. 2). Thus, each turret socket 20 is connected in fluid communication with the distributing member 52 by passages 82, 84, and 86. However, the distributing member is effective to port coolant to only the passages 82, 84, and 86 leading to the tool socket 20 which is in the working position, that is pointed downwardly toward the workpiece 17.

A plug 90 (Fig. 2) is supplied to close the end of the radial passage 82 which is opposite the opening in the receiving surface 62. This provides a coolant-tight seal.

The manifold 62 is generally cylindrical (Figs. 2 and 3). A circumferential flange extending from one end surface 92 has holes 94 to accommodate bolts 76 used to connect the manifold 62 to the turret face 18. An annular recess surrounding the interface of each passage 84 from the manifold 62 to the turret 18 has an O-ring 98 (Fig. 2) to form a coolant-tight seal between the manifold and the turret.

A hollow cylindrical center section 100 of the manifold 62 is coaxial with the outside of the manifold and of larger diameter than the receiving surface 66 of the manifold. The cylindrical distributing member 52 is inserted through the hollow portion 100 of the manifold 62. The cylindrical distributing surface 64 of the distributing member 52 is moved into telescopic engagement with the receiving surface 66 of the manifold 62. Axial motion in one direction of the distributing member 52 with respect to the manifold 62 is prevented by abutting engagement of a circumferential flange 102 with an annular stop surface 104 in the manifold. Axial motion of the distributing member 52 in the other direction is prevented by a circular snap ring 106 which is engaged in a groove 108 and abuts stop surface 110 on the manifold opposite the stop

surface 104. O-rings 112 and 114 are provided in circumferential grooves 116 and 118 to provide a coolant-tight seal between the distributing member 52 and the manifold 62.

Each socket 20 is adapted to receive a tapered end portion 120 of a tool 22 (Figs. 4-6). The socket 20 has a first lower cylindrical portion 122 (as viewed in Figs. 4, 5, and 6) and an upper second cylindrical portion 124 having a smaller diameter than the first cylindrical portion. The first and second cylindrical portions 122 and 124 are connected by a conical section 126. The tapering conical section 126 is provided to guide the tool 22 into the socket 20 while the cylindrical sections 122 and 124 serve to provide firm surfaces to align the tool 22 once it is fully seated.

In addition to and coaxial with the tapered and cylindrical sections 122, 124 and 126, the socket 20 has a cylindrical portion 128. The cylindrical portion 128 has a smaller diameter than the cylindrical portion 124. The uppermost cylindrical portion 128 is provided to hold a check valve assembly 130.

Each socket 20 includes a check valve assembly 130 which controls the flow of coolant to the socket. The check valve assembly 130 is operable between a closed condition (Fig. 4) blocking coolant flow and an open condition (Fig. 5) enabling coolant to flow. The check valve assembly 130 is operated from the closed condition to the open condition under the influence of an operating member or standpipe 132 associated with a tool 22. The check valve assembly 130 is biased to a closed position by a coil spring 134. Since the check valve assembly is biased closed it blocks coolant flow when no tool is in the socket 20, such as during the tool changing operation. The check valve assembly 130 also prevents the coolant flow when the tool 22 in the socket 20 has no operating member (Fig. 6).

The check valve assembly 130 is housed in a cylindrical member 138 having a circumferential, radially extending shoulder 140 to limit upward motion (as viewed in Figs. 4, 5 and 6) relative to the turret 18. The housing 138 has a circumferential groove 142 to hold an O-ring 144 used to make a tight seal.

When the check valve housing 138 has been inserted in the socket 20 and the shoulder 140 is in abutting engagement with the stop surface 146 on the turret, a set screw 148 is tightened to hold the check valve assembly 130 in place. The set screw 148 cooperates with threads 150 in a passage 152 which extends perpendicular to the axis of the socket 20. The set screw 148 engages a blind hole 154 in the cylindrical outside surface 156 of the check valve housing 138.

A central passage 160 extends axially through the check valve housing 138. A first part 162 of this passage, the uppermost part,

has the smallest diameter of the entire passage 160 and connects at one end with a circular end surface 164 of the housing 138. This first part 162 provides a passage through which the coolant may flow.

The second part 166, the central portion, of the passage 160 has a larger diameter than the first part. An annular surface 168 connects the uppermost and center portions of the passage 160 and makes a base against which a biasing spring 134 acts. The center cylindrical portion of the central passage 166 through the check valve housing 138 contains the biasing spring 134 and a spherical valve member 170. The central portion 166 of the passage through the check valve housing 138 has a larger diameter than the spherical valve member 170. The third portion 174 of the passage through the check valve housing 160 has a larger diameter than the second portion 166 and includes a threaded inside surface 176. This third part 174 is adapted to receive a valve seat member 180 which has cooperating threads 182.

The valve seat member 180 is cylindrical and includes a central cylindrical passage 184 which connects the two circular end surfaces 186 and 188. The upper end of this passage 184 provides a circular valve seat 190 to engage the valve member 170 when the valve assembly 130 is closed (Fig. 4). When the valve assembly 130 is in an open condition (Fig. 2), coolant flows through the passage 184 in the valve seat member 180 and into the tool 22. The valve seat member 180 is provided with a pair of blind holes 190 and 192 to engage the pins (not shown) of a wrench (not shown) to facilitate installation of the valve assembly 130.

It is not necessary to provide coolant to every tool 22 which is used in a machine tool 10 built in accordance with the present invention. With some tools coolant is required, while with other tools no coolant is required. The tools 22 which require coolant are provided with an actuator member 132 to unseat the valve member 170 as the tool is inserted into the socket 20 (Figs. 4 and 5). Each of these tools have a central passage 194 to conduct coolant to the cutting edge 24 (cutting edge 24 shown in Fig. 1 only).

The end portion of a tool 120 adapted to be received in the socket of the turret 18 has two cylindrical surfaces 186 and 198 connected by a tapering surface 200. The cylindrical surfaces 196 and 198 cooperate with corresponding surfaces 122 and 124 in the socket 20 and serve to hold the tool in a position coaxial with the socket 20. Coaxial with the tool end portion 120 is a cylindrical recess 202 extending down from an upper end surface 204. This recess 202 receives the cylindrical portion 206 of the check valve housing 138 which extends downward below the flange 140 of the housing.

A standpipe or valve actuator 132 extends up from the circular bottom 208 of the recess 202 in the tool 22. The pipe 132 is coaxial with the recess 202 and serves as an actuator to unseat the valve member 170 as the tool is inserted into the socket 20. As the tool 22 is inserted into the socket 20, the pipe 132 is inserted into the passage 184. An O-ring 210 seated in an annular groove 212 around the perimeter of the pipe 132 provides a coolant-tight seal between the valve seat member 180 and the pipe. When the tool 22 is fully seated in socket 20, the pipe 132 extends up through the valve seat 190 and holds the valve member 170 off the seat 190 against the influence of the biasing spring 134.

Radial passages 220 connect the outside of the pipe 132 with the cylindrical passage 194 inside of the pipe. Coolant can then flow from the central passage 160 in the check valve housing 138 around the outside of the valve member 170 and into the inside of the pipe 132 along a path indicated by the arrow 22 (Fig. 5). The end portion 222 (Fig. 5) of the pipe 132 opposite the radial passages 220 the pipe has threads 224 which engage a threaded end portion 226 of a passage 228 through the tool 22. The passage 228 extends through the center of the tool 22 to the cutting edge 24.

Thus when a tool 22 is inserted into the socket 20 the valve member 170 is lifted from the valve seat 190 to enable coolant to flow to the cutting edge 24 of the tool. However, if the tool 22 is not provided with a pipe 132 to lift the valve member 170 off the valve seat 190, the coolant will not flow to the tool (Fig. 6). Additionally, the coolant will flow only to the socket 20 which is indexed to the working position. The distributing member 62 provides that the coolant will be directed only to one socket 20 at a time, and this socket is the one which is in the working position.

Although the check valve assembly 130 and actuating member 132 have been described with reference to a machine tool 10 having a rotatable turret 18, it is to be understood that the check valve 132 assembly may be used with a machine tool having a single socket and no turret. It should also be noted that the check valve assembly 130 not only shuts off coolant flow when the tool 22 which is inserted into the socket 20 is not equipped with an actuator member 132, is also prevents the loss of coolant during the changing of tools. If the check valve assembly 130 were not present, when a tool 22 is being changed, the coolant would flow freely out of the turret 18 and onto the carousel 32. In order to prevent this, a valve would be required to eliminate the flow of coolant or the pump would have to be turned off. The check valve assembly 130 of the present invention eliminates the necessity of these devices.

Thus it is clear that the present invention provides a new and improved coolant system 12 having a distributor 50 which ports coolant only to the socket 20 indexed to the

5 working position. A non-rotatable distributing member 52 has a single coolant outlet 56 disposed on a cylindrical surface 64. A manifold 62 is fixedly connected to and coaxial with the turret 18 of the machine tool 10. It includes a separate passage 60 associated with each socket 20 for conducting coolant from a receiving surface 66 on the manifold 52 to the associated socket. The receiving ends 80 of these passages 60 are in  
15 alignment with the coolant outlay 56 only when the associated socket 20 has been indexed to the working position.

In addition, the present invention provides a check valve assembly 130 in each socket 20 and an actuator member 132 on selected tools. This enables coolant to flow only when a tool 22 is in the socket 20 and then only when the tool is equipped with an actuator member 132. The check valve assembly 132  
25 includes a circular valve seat 190 and a spherical valve member 170. A biasing spring 134 urges the valve member 170 toward a closed position abutting the valve seat 190. If the tool 22 is one which requires coolant, it is  
30 equipped with a pipe 132 which will project upwardly through the valve seat 190 to lift the valve member 170 off the valve seat when the tool is inserted in the socket 22. Tools not requiring coolant are not equipped with a pipe (Fig. 6). Therefore the check valve assembly is not opened when one of these  
35 tools is inserted into a socket 22.

#### CLAIMS

40 1. A machine tool assembly comprising a base, a rotatable turret connected with said base, said turret having a plurality of recesses each of which is adapted to receive a portion of a tool having a cutting edge, said turret  
45 being rotatable to selectively index each tool receiving recess to a working position, a source of pressurized coolant, a plurality of conduits on the turret, each of said conduits being associated with one of the tool receiving  
50 recesses on said turret and being adapted to direct a flow of coolant toward the cutting edge of a tool disposed in the associated recess, distributing means for directing a flow of coolant from said source to the conduit  
55 associated with a tool receiving recess disposed in the working position, said distributing means including surface means for porting coolant to the one conduit associated with the tool receiving recess in the working position  
60 and blocking the flow of coolant to the other conduits.

2. A machine tool assembly as set forth in claim 1 wherein said surface means for porting coolant includes a non-rotatable distribut-  
65 ing surface and rotatable receiving surface

disposed in sliding abutting engagement with said distributing surface, said distributing surface defining an outlet connected with said source, said receiving surface defining a plu-  
70 rality of inlets each of which is connected with one of said conduits, said receiving surface being rotatable with said turret to enable coolant to flow from said outlet through a selected one of said inlets and a conduit

75 toward the cutting edge of a tool disposed in the tool receiving recess indexed to the working position.

3. A machine tool assembly as set forth in claim 1 further including a valve means asso-  
80 ciated with each of said conduits for controlling coolant flow through each of said conduits toward the cutting edge of a tool received in the recess of the associated conduit, said valve means being operable between a closed  
85 condition preventing coolant flow and an open condition enabling coolant to flow, said valve means including biasing means for urging said valve means to said closed condition, actuator means associated with the tools for  
90 operating said valve means from said closed position to said open position.

4. A machine tool assembly comprising a tool having a cutting edge, at least one socket adapted to releasably receive said tool, a  
95 source of pressurized coolant, a conduit adapted to conduct coolant from said source to said socket, passage means connected with said tool for conducting a coolant from said socket to the cutting edge of said tool, valve means for controlling coolant flow from said conduit to said passage means, said valve means being operable between a closed con-  
100 dition blocking coolant flow and an open condition enabling coolant to flow through said passage means, said valve means including biasing means for urging said valve means toward the closed condition, actuator means connected with said cutting tool for operating said valve means from the closed condition to  
110 the open condition as said cutting tool is received in said socket.

5. A machine tool assembly as set forth in claim 4 further including a second tool having a cutting edge, said second tool being ineffec-  
115 tive to operate said valve means from the closed condition to the open condition.

6. A machine tool assembly as set forth in claim 4 further including a plurality of cutting tools, a turret, a plurality of sockets disposed  
120 on said turret each of said sockets being adapted to releasably receive any one of said tools, said turret being rotatable to selectively index each socket to a working position, said conduit including distributing means for di-  
125 recting a flow of coolant from said source to the one socket indexed to the working position and for blocking the flow of coolant to the other sockets.

7. A machine tool assembly as set forth in  
130 claim 4 wherein said tool includes a mounting

end portion adapted to be received in said socket and a shank upon which shank said cutting edge is disposed, said passage extending through said tool from said mounting end portion to a location on said shank near said cutting edge.

8. A machine tool assembly as set forth in claim 4 wherein said actuator means includes a member adapted to disengage said valve member from said valve seat against the urging of the biasing spring.

9. A machine tool assembly as set forth in claim 4 wherein said valve member means includes a valve body having a valve seat, a valve member adapted to sealingly engage said valve seat, and said biasing means includes spring means for urging said valve member into engagement with said valve seat.

10. A device as set forth in claim 9 wherein said valve member is spherical and wherein said valve body includes surface means for defining a cylindrical passage through said valve body, said surface means having an axis extending through the center of said valve member, said actuator means including a tubular member having an interior and an exterior, said interior being connected with said passage means and said exterior being connected with said conduit, said tubular member having a circular end portion adapted to engage said spherical valve member and to lift it off said valve seat as said tool is received in said socket, said tubular member having surface means for enabling coolant to flow from said exterior of said tubular member to said interior of said tubular member by defining a passage intermediate opposite ends of said tubular member and interconnecting said exterior and said interior of said tubular member.